



## Product Information

ISSUED DATE : 2007-04-11

**SAMSUNG TFT-LCD PRODUCT INFORMATION****MODEL : LTM240CT03**

Note : This is Product Information is subject to change after 3 months of issuing date.

Development Team 4, LCD Business

Samsung Electronics Co . , LTD.



MODEL

LTM240CT03

Doc. No

PI-000-LTM240CT03

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## General Description

### Product Information

### Description

LTM240CT03 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 24.0" is 1920 x 1200 and this model can display up to 16.7 millions colors.

### Features

- High contrast ratio, high aperture structure, [High Color Gamut](#)
- TN (Twisted Nematic) mode
- Wide Viewing Angle
- High speed response
- Wide UXGA (1920 x 1200 pixels) resolution
- Low power consumption
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)
- Direct B/L Unit Design
- RoHS compliance
- Pb Free compliance

### Applications

- Workstation & desktop monitors
  - Display terminals for AV application products
  - Monitors for industrial machine
- \* If the module is used to other applications besides the above, please contact SEC in advance.

## General Information

Items	Specification	Unit	Note
Pixel Pitch	0.270(H) x 0.270(W)	mm	
Active Display Area	518.4(H) x 324.0(V)	mm	
Surface Treatment	ARC Glare		
Display Colors	16.7M (Hi-FRC)	colors	
Number of Pixels	1920 x 1200	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally White		
Luminance of White	400(Typ.)	cd/m <sup>2</sup>	

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## Product Information

- (1) Temperature and relative humidity range are shown in the figure below.
  - a. 90 % RH Max. ( $T_a \leq 39\text{ }^{\circ}\text{C}$ )
  - b. Maximum wet-bulb temperature at  $39\text{ }^{\circ}\text{C}$  or less. ( $T_a \leq 39\text{ }^{\circ}\text{C}$ )
  - c. No condensation
- (2) 11ms, sine wave, one time for  $\pm X$ ,  $\pm Y$ ,  $\pm Z$  axis
- (3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

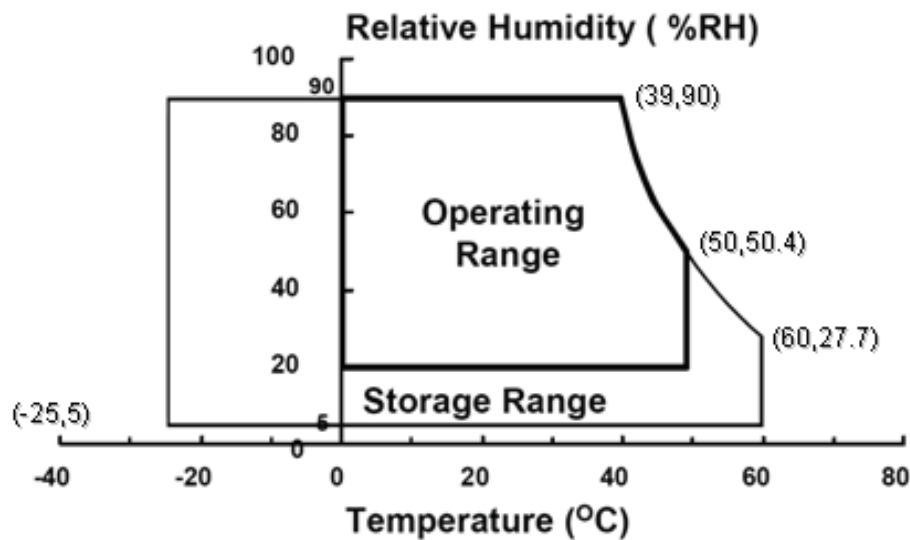


Fig. Temperature and Relative humidity range

## Product Information

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Gamut		-		-	92	-	%	
Color Temperature		-		-	6500	-	K	
Viewing Angle	Hor.	$\theta_L$	CR≥10	70	80	-	Degrees	(8) EZ-Contrast
		$\theta_R$		70	80	-		
	Ver.	$\theta_U$		70	80	-		
		$\theta_D$		70	80	-		
Brightness Uniformity (9 Points)		B <sub>uni</sub>		-	-	25	%	(4) SR-3

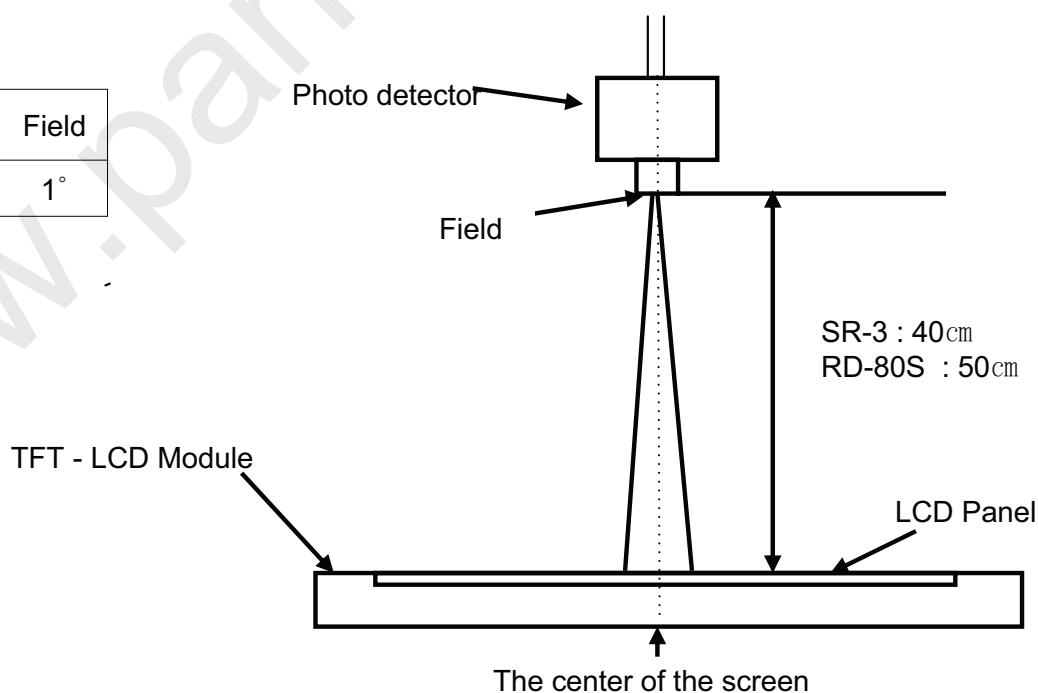
## Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 30min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Single lamp current : 6.0mA

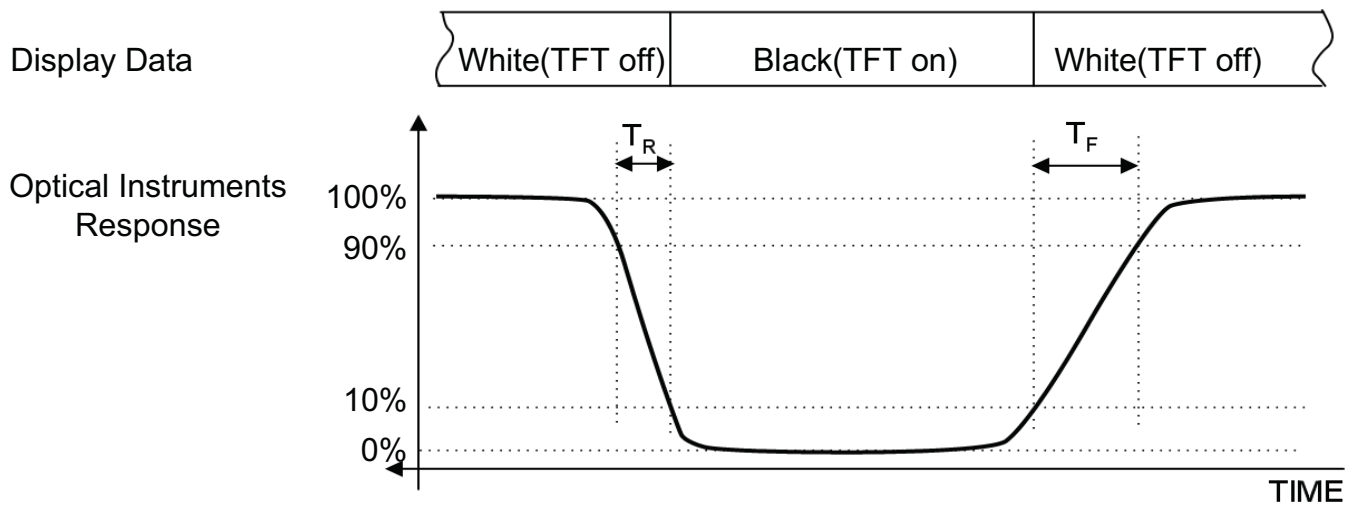
Environment condition :  $T_a = 25 \pm 2^\circ\text{C}$

Photo detector	Field
SR-3	1°



## Product Information

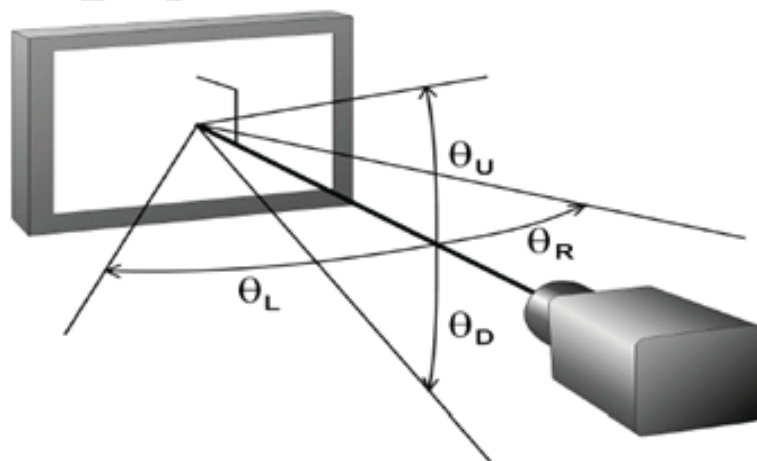
Note (5) Definition of Response time : Sum of  $T_R$ ,  $T_F$



Note (6) Definition of Luminance of White : Luminance of white at center point⑤

Note (7) Definition of Color Chromaticity (CIE 1931, CIE1976)  
Color coordinate of Red, Green, Blue & White at center point⑤

Note (8) Definition of Viewing Angle  
: Viewing angle range ( $CR \geq 10$ )



### 3. Electrical Characteristics

#### Product Information

#### 3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

Ta = 25°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		$V_{DD}$	4.5	5.0	5.5	V	(1)
LVDS Input Characteristics	Differential Input Voltage for LVDS Receiver Threshold	High	-	-	+100	mV	(2)
		Low	-100	-	-	mV	
	LVDS skew	$t_{SKEW}$	-300		300		(3)
	Differential input voltage	$ V_{ID} $	200		600	mV	(4)
	Input voltage range (single-ended)	$V_{IN}$	0		2.4	V	(4)
	Common mode voltage	$V_{CM}$	0+ $ V_{ID} /2$	1.2	2.4- $ V_{ID} /2$	V	(4)
	Input current	$I_{IN}$			$\pm 10$	$\mu A$	
Current of Power Supply	(a) Black	$I_{DD}$	-	1,700	2,000	mA	(5),(6)
	(b) White		-	2,000	2,300	mA	
	(c) Dot		-	2,400	3,000	mA	
Vsync Frequency		$f_V$	53	60	63	Hz	
Hsync Frequency		$f_H$	65	74	78	kHz	
Main Frequency		$f_{DCLK}$	68	77	81	MHz	
Rush Current		$I_{RUSH}$	-	-	5.0	A	(7)

Note (1) The ripple voltage should be controlled under 10% of  $V_{DD}$ .

## Product Information

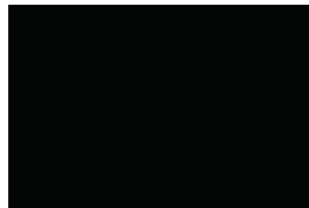
(5)  $f_V=60\text{Hz}$ ,  $f_{\text{DCLK}} = 54\text{MHz}$ ,  $V_{\text{DD}} = 5.0\text{V}$ , DC Current.

(6) Power dissipation check pattern (LCD Module only)

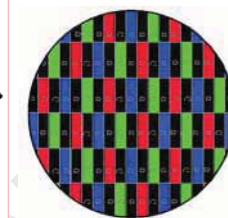
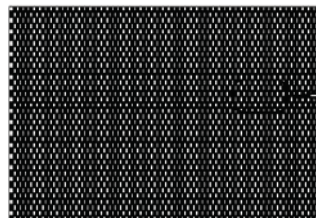
a) White Pattern



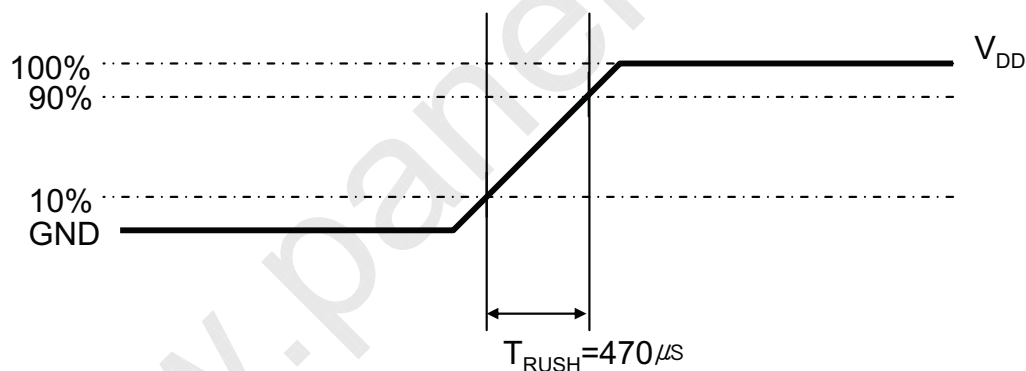
b) Black Pattern



c) Dot Pattern



(7) Measurement Condition



Rush Current  $I_{\text{RUSH}}$  can be measured when  $T_{\text{RUSH}}$  is  $470\mu\text{s}$ .

## Product Information

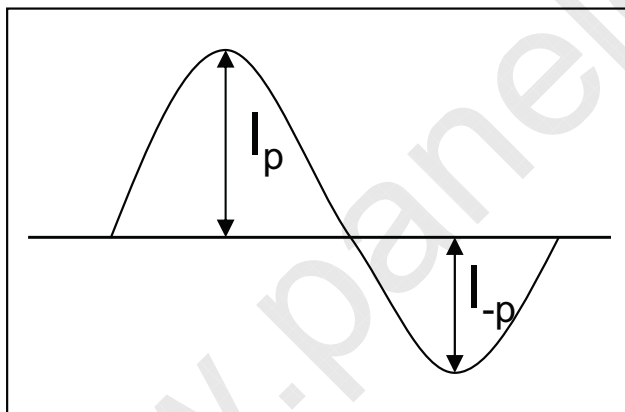
(2) Lamp frequency which may produce interference with horizontal synchronous frequency may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Life time (Hr) is defined as the time when brightness of a lamp unit itself becomes 50% or less than its original value at the condition of  $T_a = 25 \pm 2^\circ\text{C}$  and  $I_L = 6.0\text{mA}_{\text{rms}}$

(4) Designing a system inverter intended to have better display performance, power efficiency and lamp reliability.

They would help increase the lamp lifetime and reduce leakage current.

- The measurement should be done at typical lamp current.
- The asymmetry rate of the inverter waveform should be less than 10%.
- The distortion rate of the waveform should be  $\sqrt{2}$  with  $\pm 10\%$  tolerance.
  - Inverter output waveform had better be more similar to ideal sine wave.



**Fig. Wave form of the inverter**

- Asymmetry rate

$$\frac{|I_p - I_{-p}|}{I_{\text{rms}}} \times 100$$

- Distortion rate

$$\left| \frac{I_p}{I_{\text{rms}}} \right| \text{ or } \left| \frac{I_{-p}}{I_{\text{rms}}} \right|$$

(5) If an inverter has shutdown function, it should keep its output for over 1 second even if the lamp connector is open. Otherwise the lamps may not be turned on.



## 5. Input Terminal Pin Assignment

### Product Information

#### 5.1. Input Signal & Power ( Connector : UJU, IS100-L30O-C23 or equivalent )

PIN NO	SYMBOL	FUNCTION
1	RX00N	Negative LVDS differential data output
2	RX00P	Positive LVDS differential data output
3	RX01N	Negative LVDS differential data output
4	RX01P	Positive LVDS differential data output
5	RX02N	Negative LVDS differential data output
6	RX02P	Positive LVDS differential data output
7	GND	Ground
8	RXOC-	Negative Sampling Clock (ODD data)
9	RXOC+	Positive Sampling Clock (ODD data)
10	RX03N	Negative LVDS differential data output
11	RX03P	Positive LVDS differential data output
12	RXE0N	Negative LVDS differential data output
13	RXE0P	Positive LVDS differential data output
14	GND	Ground
15	RXE1N	Negative LVDS differential data output
16	RXE1P	Positive LVDS differential data output
17	GND	Ground
18	RXE2N	Negative LVDS differential data output
19	RXE2P	Positive LVDS differential data output
20	RXEC-	Negative Sampling Clock (EVEN data)
21	RXEC+	Positive Sampling Clock (EVEN data)
22	RXE3N	Negative LVDS differential data output
23	RXE3P	Positive LVDS differential data output
24	GND	Ground
25	NC	* CE (For LCD internal use only. Do not connect)
26	NC	* CTL (For LCD internal use only. Do not connect)
27	VDD	Power Supply : +5V
28	VDD	
29	VDD	
30	VDD	

\* If the system already uses the 25, 26pins, it should keep under GND level  
The voltage applied to those pins should not exceed -200mV.



## Product Information

## 5.2 LVDS Interface

## 5.2.1 Odd Pixel Data (1st pixel data)

1st LVDS Transmitter ( <b>DS90C383</b> , <b>DS90C385</b> ) Signal Interface						
Device Input Pin		Device Input Signal		Output Signal	To LTM240M2 Interface ( CN1 )	
No	Symbol	Symbol	Function		Terminal	Symbol
51	TXIN0	RO0	Red Odd Pixel Data (LSB)	TXOUT0- TXOUT0+	No. 1 No. 2	RXO0- RXO0+
52	TXIN1	RO1	Red Odd Pixel Data			
54	TXIN2	RO2	Red Odd Pixel Data			
55	TXIN3	RO3	Red Odd Pixel Data			
56	TXIN4	RO4	Red Odd Pixel Data			
2	TXIN5	RO7	Red Odd Pixel Data (MSB)	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+
3	TXIN6	RO5	Red Odd Pixel Data	TXOUT0- TXOUT0+	No. 1 No. 2	RXO0- RXO0+
4	TXIN7	GO0	Green Odd Pixel Data (LSB)			
6	TXIN8	GO1	Green Odd Pixel Data	TXOUT1- TXOUT1+	No. 3 No. 4	RXO1- RXO1+
7	TXIN9	GO2	Green Odd Pixel Data			
8	TXIN10	GO6	Green Odd Pixel Data	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+
10	TXIN11	GO7	Green Odd Pixel Data (MSB)			
11	TXIN12	GO3	Green Odd Pixel Data	TXOUT1- TXOUT1+	No. 3 No. 4	RXO1- RXO1+
12	TXIN13	GO4	Green Odd Pixel Data			
14	TXIN14	GO5	Green Odd Pixel Data			
15	TXIN15	BO0	Blue Odd Pixel Data (LSB)			
16	TXIN16	BO6	Blue Odd Pixel Data	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+
18	TXIN17	BO7	Blue Odd Pixel Data (MSB)			
19	TXIN18	BO1	Blue Odd Pixel Data	TXOUT1- TXOUT1+	No. 3 No. 4	RXO1- RXO1+
20	TXIN19	BO2	Blue Odd Pixel Data	TXOUT2- TXOUT2+	No. 5 No. 6	RXO2- RXO2+
22	TXIN20	BO3	Blue Odd Pixel Data			
23	TXIN21	BO4	Blue Odd Pixel Data			
24	TXIN22	BO5	Blue Odd Pixel Data			
50	TXIN27	RO6	Red Odd Pixel Data	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+



## Product Information

## 5.3 LVDS Interface(2)

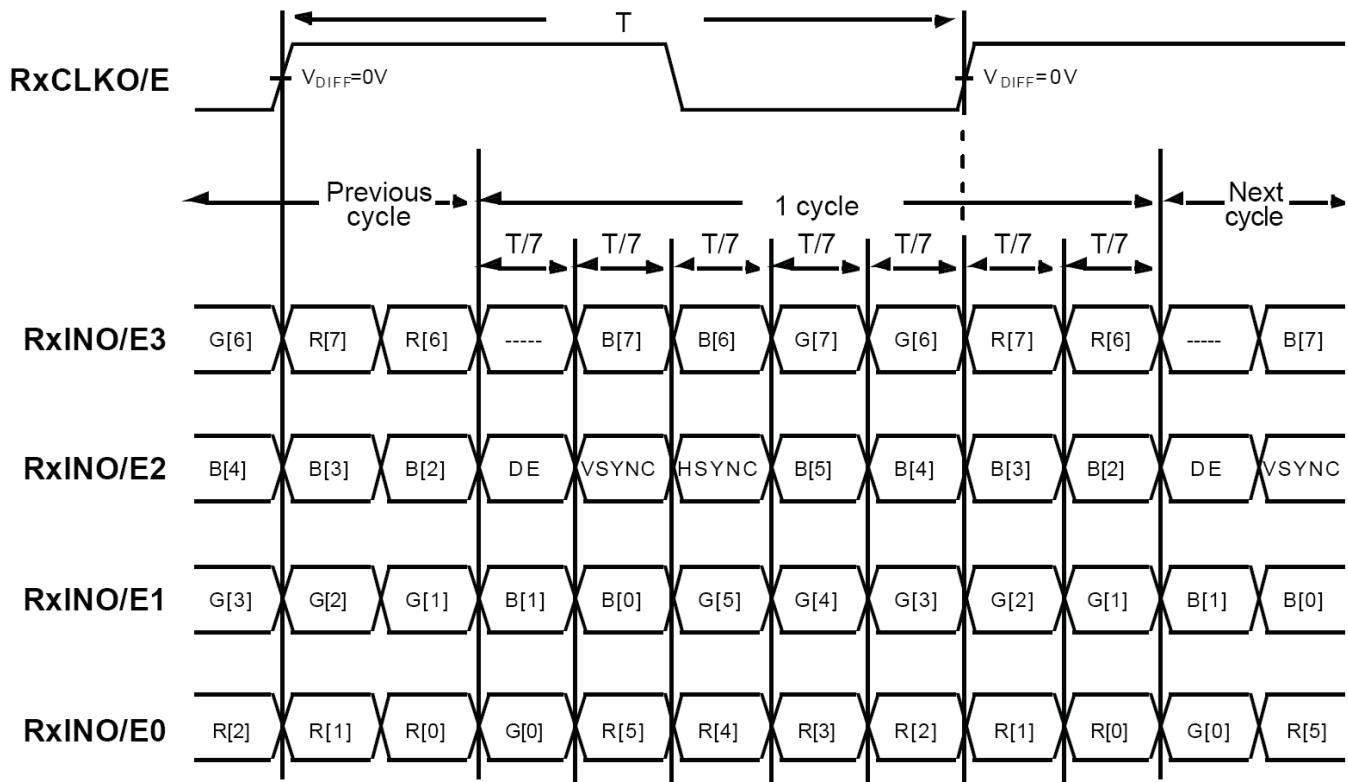
## 5.3.1 Odd Pixel Data (1st pixel data)

LVDS Transmitter ( <b>DS90C387</b> ) Signal Interface						
Device Input Pin		Device Input Signal		Output Signal	To LTM240M2 Interface ( CN1 )	
No	Symbol	Symbol	Function		Terminal	Symbol
10	R10	RO0	Red Odd Pixel Data (LSB)	A0M A0P	No. 1 No. 2	RXO0- RXO0+
9	R11	RO1	Red Odd Pixel Data			
8	R12	RO2	Red Odd Pixel Data			
7	R13	RO3	Red Odd Pixel Data			
6	R14	RO4	Red Odd Pixel Data			
3	R17	RO7	Red Odd Pixel Data (MSB)	A3M A3P	No. 10 No. 11	RXO3- RXO3+
5	R15	RO5	Red Odd Pixel Data	A0M A0P	No. 1 No. 2	RXO0- RXO0+
2	G10	GO0	Green Odd Pixel Data (LSB)			
1	G11	GO1	Green Odd Pixel Data	A1M A1P	No. 3 No. 4	RXO1- RXO1+
100	G12	GO2	Green Odd Pixel Data			
94	G16	GO6	Green Odd Pixel Data	A3M A3P	No. 10 No. 11	RXO3- RXO3+
93	G17	GO7	Green Odd Pixel Data (MSB)			
99	G13	GO3	Green Odd Pixel Data	A1M A1P	No. 3 No. 4	RXO1- RXO1+
96	G14	GO4	Green Odd Pixel Data			
95	G15	GO5	Green Odd Pixel Data			
92	B10	BO0	Blue Odd Pixel Data (LSB)			
86	B16	BO6	Blue Odd Pixel Data	A3M A3P	No. 10 No. 11	RXO3- RXO3+
85	B17	BO7	Blue Odd Pixel Data (MSB)			
91	B11	BO1	Blue Odd Pixel Data	A1M A1P	No. 3 No. 4	RXO1- RXO1+
90	B12	BO2	Blue Odd Pixel Data	A2M A2P	No. 5 No. 6	RXO2- RXO2+
89	B13	BO3	Blue Odd Pixel Data			
88	B14	BO4	Blue Odd Pixel Data			
87	B15	BO5	Blue Odd Pixel Data			
4	R16	RO6	Red Odd Pixel Data	A3M A3P	No. 10 No. 11	RXO3- RXO3+

## Product Information

### 5.3.3 Timing Diagrams of LVDS For Transmitting

LVDS Receiver : Integrated T-CON





## Product Information

## 5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLO R	DISPLAY (8bit)	DATA SIGNAL																										GRAY SCALE LEVEL
		RED								GREEN								BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7			
BASIC COLO R	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	-	
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	-	
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	
	MAGENTA A	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	-	
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	-	
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0	
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1	
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:				R3~ R252	
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:					
	↓ LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253	
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254	
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255	
GRAY SCALE OF GREE N	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0	
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1	
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2	
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:				G3~ G252	
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:					
	↓ LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G253	
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G254	
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G255	
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0	
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	B1	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B2	
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:				B3~ B252	
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:					
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	B253	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B254	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B255	

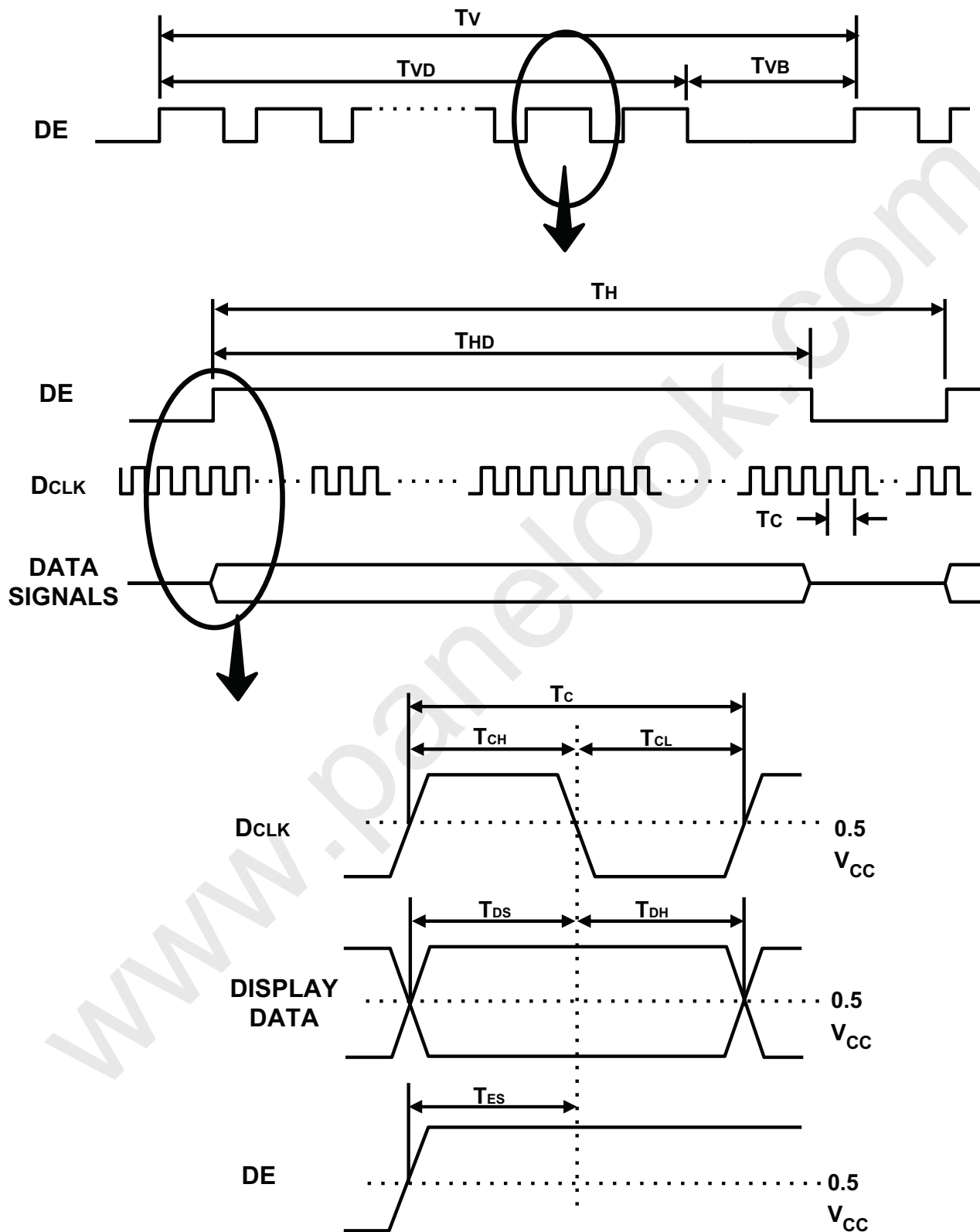
Note (1) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

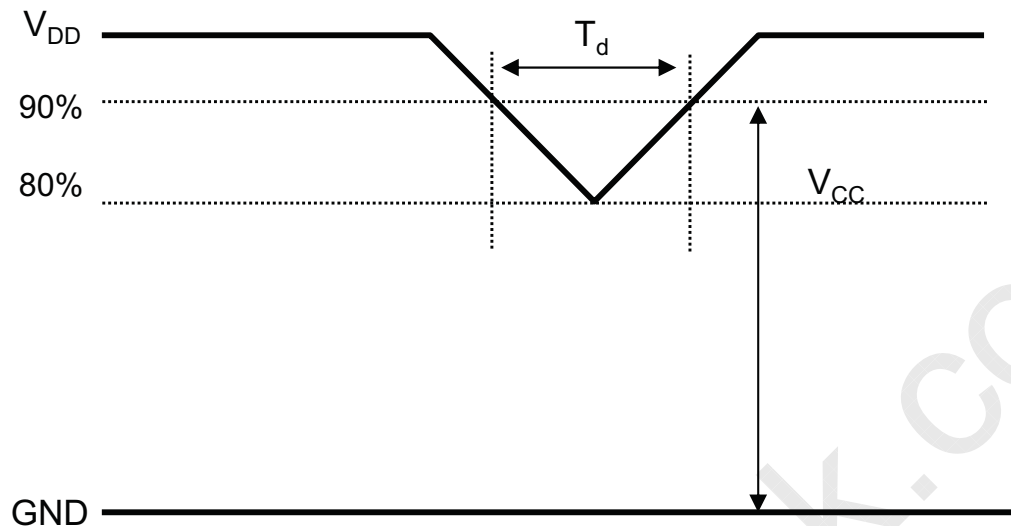
## Product Information

## 6.2 Timing diagrams of interface signal ( DE only mode )



## Product Information

## 6.5 VDD Power Dip Condition



$4.5V \leq V_{DD} \leq 5.5V$   
If  $V_{DD}(\text{typ.}) \times 80\% \leq V_{CC} \leq V_{DD}(\text{typ}) \times 90\%$   
Then,  $0 < T_d \leq 20\text{msec}$

- Note (1) The above conditions are for the glitch of the input voltage.  
(2) For stable operation of an LCD Module power, please follow them.  
i.e., if  $\text{typ VDD} \times 80\% \leq V_{cc} \leq \text{typ VDD} \times 90\%$ , then  $T_d$  should be less than 20ms.





## Product Information

## 8.2 Storage

- (a) Do not leave the Module in high temperature, and high humidity for a long time. It is highly recommended to store the Module with temperature from 0 to 35℃ and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD Module in direct sunlight.
- (c) The Module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

## 8.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the item 6.3 "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

## 8.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.  
Normal condition is defined as below;
  - Temperature :  $20 \pm 15^{\circ}\text{C}$
  - Humidity :  $65 \pm 20\%$
  - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.